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ABSTRACT

The purpose of this study was to demonstrate the feasibility and cost effectiveness of a microfiche-based audio/visual facility and to solicit user opinions and recommendations regarding this medium. Twenty instructors and 20 trainees at the Basic Electricity and Electronics School, Orlando, Florida, reviewed four sound/microfiche programs and were asked to compare this medium with their experience using sound/slide programs. The microfiche medium was positively received by both groups. Recommendations for future development and use of sound/microfiche programs as well as comparative cost analyses are presented. (Author)

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Technical Memorandum 77-2

DEMONSTRATION AND EVALUATION OF A MICROFICHE-BASED AUDIO/VISUAL SYSTEM

William A. Rizzo

Training Analysis and Evaluation Group

April 1977

Sponsored by

Chief of Naval Education and Training

and the

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Naval Technical Information Presentation Program

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The purpose of this study was to demonstrate the feasibility and cost effectiveness of a microfiche-based audio/visual facility and to solicit user opinions and recommendations regarding this medium. Twenty instructors and 20 trainees at the Basic Electricity and Electronics School, Orlando, Florida, reviewed four sound/microfiche programs and were asked to compare this medium with their experience using sound/slide programs. The microfiche medium was positively received by both groups. Recommendations for future development

20. ABSTRACT (continued)

and use of sound/microfiche programs as well as comparative cost analyses are presented.

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FOREWORD

This study demonstrated the use of sound/microfiche audio/visual programs in a technical training environment, evaluated user reaction to this medium, and compared costs with traditional sound/slide programs. Technical advice and assistance of Dr. Richard Braby (TAEG), Dr. William Swope (TAEG), Ms. Susan Bellomy (TAEG), and Mr. James Eastman (Kodak, Rochester) are greatly appreciated. A special thanks is extended to TMCS Ralph Comp (Basic Electricity and Electronics School, Orlando) for providing the hardware resources required for the study and for the orderly scheduling of instructors and trainees used as subjects.

SECTION I

INTRODUCTION

Audio/visual (A/V) programs consisting of audio cassettes and color slides are used extensively in Navy schools and in onboard training. These sound/slide programs are used as less expensive substitutes for motion pictures when motion is not essential to the presentation.

The sound/slide programs were originally designed to be used by instructors in presenting information to groups of students. Today, they are often used in support of individualized and self-paced instruction. As more and more courses are individualized and self-paced in accordance with CNET policy and Instructional System Development (ISD) procedures, there is a growing need for A/V packages designed for individual users.

Sound/slide programs, while less expensive than motion pictures, require considerably more space and are more expensive to reproduce than alternative media. When supporting individualized rather than group instruction, factors such as space requirements and per unit cost become significant.

An alternative to sound/slides is the use of microfiche for the visual presentation. Color microfiche with audio cassettes are being used in place of sound/slide programs in a few training programs. Medical schools have been pioneers in the use of this medium, reproducing specimen slide sets on microfiche available to students, with or without accompanying audio tapes. Also, Eastman Kodak produced a series of sound/microfiche programs on the servicing and repair of various Kodak equipment. In the Kodak programs, technical data as well as the instructional materials are presented on microfiche.

Within the Naval Technical Information Presentation Program (NTIPP), various types of media are being evaluated for use in presenting technical information to various users. The feasibility, cost effectiveness, and user acceptance of various media are being studied. Microfiche is expected to be widely used in the 1980's as it is inexpensive to produce, distribute, store, and update. However, many questions remain unanswered regarding the use of microfiche for training purposes.

The Training Analysis and Evaluation Group (TAEG), with NTIPP support, has an ongoing program to evaluate the potential use of microfiche for Navy training. These studies include microfiche reader design considerations, effects of microfiche versus paper on technical training, user acceptance, and the design and evaluation of onboard training packages distributed as microfiche.

PURPOSE

The purpose of this study was to demonstrate the sound/microfiche concept as a substitute for sound/slides in a technical training environment. Instructors and students at the Basic Electricity and Electronics (BE&E) School, Service School Command, Orlando, Florida, examined microfiche-based A/V programs which were adaptations of the sound/slide programs currently used at the school. A secondary purpose was to sample the attitudes and recommendations of instructors and trainees regarding the new medium. Finally, cost comparisons were made of alternative A/V systems.

SECTION II

METHOD

The BE&E School, Service School Command, Orlando, was selected as the testbed for this study as it was considered representative of Navy technical training facilities. Several features of this school made it an ideal environment to demonstrate the microfiche medium.

1. The curriculum is individualized and self-paced.
2. Sound/slide programs are used as adjunct instruction.
3. Trainees use microfiche for test taking.
4. All hardware required for this study was on hand in the school.

SUBJECTS

Twenty instructors and 20 trainees at the BE&E School, Orlando, reviewed the sound/microfiche presentations. The instructors ranged in age from 24 to 37 (median = 27.5) and in pay grades E5-E8 (median = E6). All instructors were familiar with the existing sound/slide presentations and the use of the Realist/Vantage I microfiche readers. The trainees ranged in age from 18 to 21 (median = 18.5) and in pay grades E1-E3 (median = E3). Trainee subjects were randomly selected from those in the final module (14) of training to insure that all had received an equivalent amount of BE&E training. All trainee subjects had viewed at least one sound/slide presentation and had used the Realist/Vantage I reader for testing throughout their BE&E training.

STIMULUS MATERIALS

The BE&E School currently maintains 21 sound/slide programs covering a range of topics in the curriculum. Most of these programs serve as an optional form of instruction and are used at the discretion of the individual trainee if he feels the need for an additional source of information. Four sound/slide programs were selected which are representative of the range of topics, quality, and type of original inputs (e.g., artwork, schematics, equipment, graphs). These programs are described as follows:

Module	Lesson	No. of Frames	Title
3	3	53	Resistor Color Code
13	2	38	Series AC Circuits at Resonance
13	4	51	VTVM
14	4	76	Parallel AC Circuits at Resonance

The program on Resistor Color Code consists of a series of photographs of resistors and corresponding scales. The intent is to train the identification of resistor values according to their color coding. Parallel AC Circuits at Resonance addresses the use of algebraic equations, graph interpretation, and vector analysis. The graphics are simple, bold, and clear. Series AC Circuits at Resonance is similar in content; however, the graphics are less bold and more detailed. The VTVM program details the set up and use of the vacuum tube voltmeter. It consists of several photographs of a voltmeter dial and related switches. In normal use, these A/V programs require that the trainee make responses on answer sheets to technical aspects of content; however, for this demonstration, the subjects were asked to attend to qualitative aspects of the medium rather than respond to the technical training.

The color slides were converted to color microfiche by Eastman Kodak, Rochester, New York. A 98 frame, 24X microfiche format was used. The first frame (A1) of each microfiche contained a frame sequence diagram depicting the "S" pattern of information flow. Each frame contained the appropriate alphanumeric designator and an arrow pointing in the direction of the next sequential frame (figure 1).

The audio portions of the programs were edited and re-recorded to include preliminary instructions on how to use the microfiche reader and frame change directions. A male voice narrated the textual material and a contrasting female voice provided the instructions and frame change directions. The original tapes used an audible tone to signal a slide change. This appears to be adequate since slide sequencing is strictly linear. However, it was felt that more specific frame change directions were necessary for the microfiche as the operator is free to move the presentation in four directions, increasing the likelihood of getting "lost."

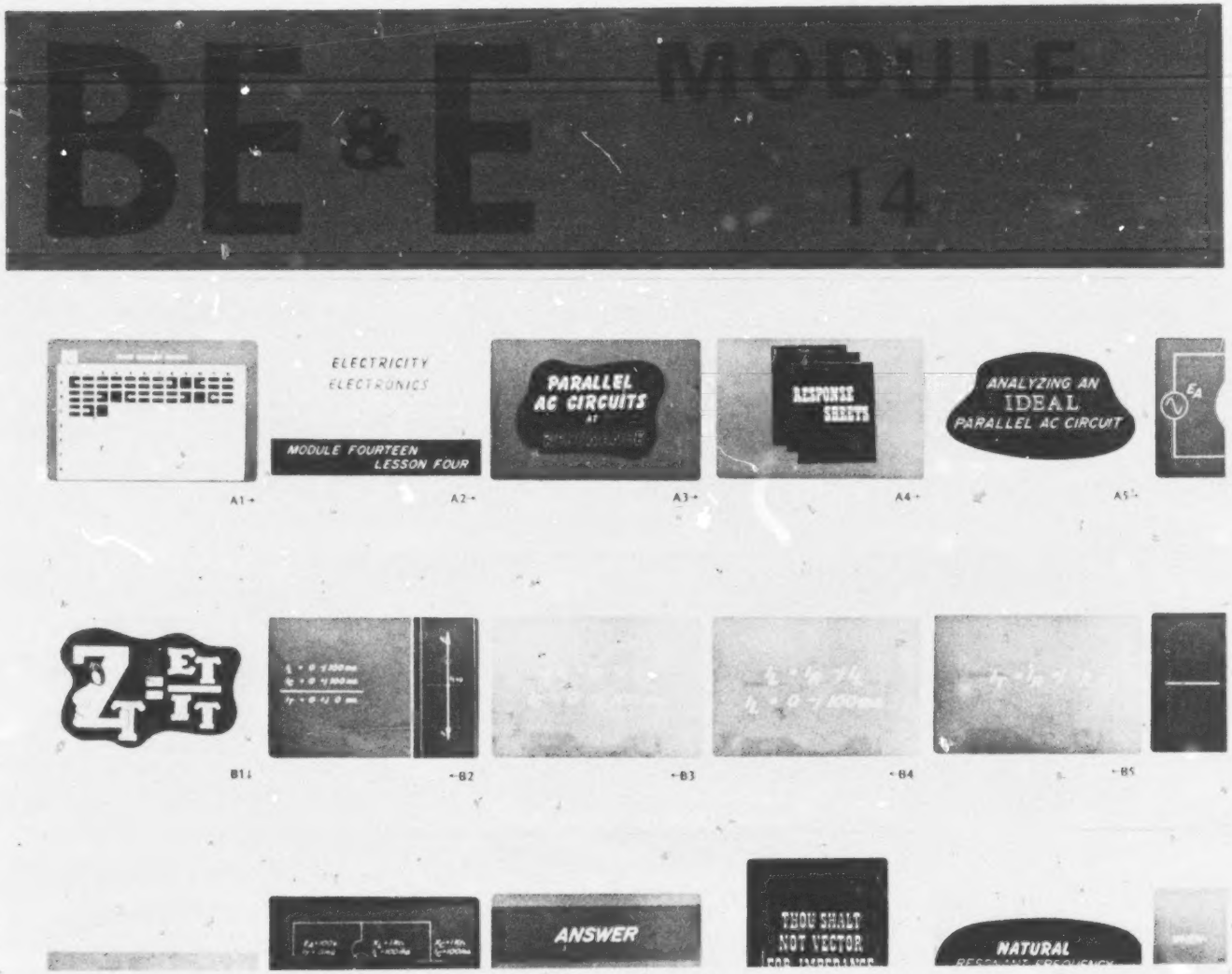

Figure 1. Sample of BE&E Microfiche

EQUIPMENT

Subjects reviewed the sound/microfiche presentations in one of four learning carrels (figure 2). Each carrel was equipped with a Realist/ Vantage I microfiche reader and a Bell and Howell Model 3025 cassette tape player with headset.

The audio tapes were recorded in a sound studio using a Wollensak cassette recorder, Model 2595 AV.

PROCEDURE

Within two categories (instructors and trainees), subjects were assigned to one of four groups by randomized blocking. The purpose of this scheme (figure 3) was to control for the effects of the audio presentation by insuring that each group experienced an audio presentation and that sound was tested with each of the microfiche presentations.

	GROUP			
	1	2	3	4
	AV	V	V	V
	V	AV	V	V
	V	V	AV	V
	V	V	V	AV

AV = Audio/Visual review
V = Visual review only

Figure 3. Mode of Presentation for Sound/Microfiche Programs

Four subjects reviewed the programs simultaneously. Each was provided a set of four microfiche and one audio tape. Subjects were instructed to first review the microfiche with the corresponding audio, then visually review the remaining three microfiche in any order. Subjects were asked to fill in a questionnaire (appendix A) at the completion of the task. The questionnaire required the subjects to compare the sound/microfiche demonstration with their previous experience using sound/slide programs.

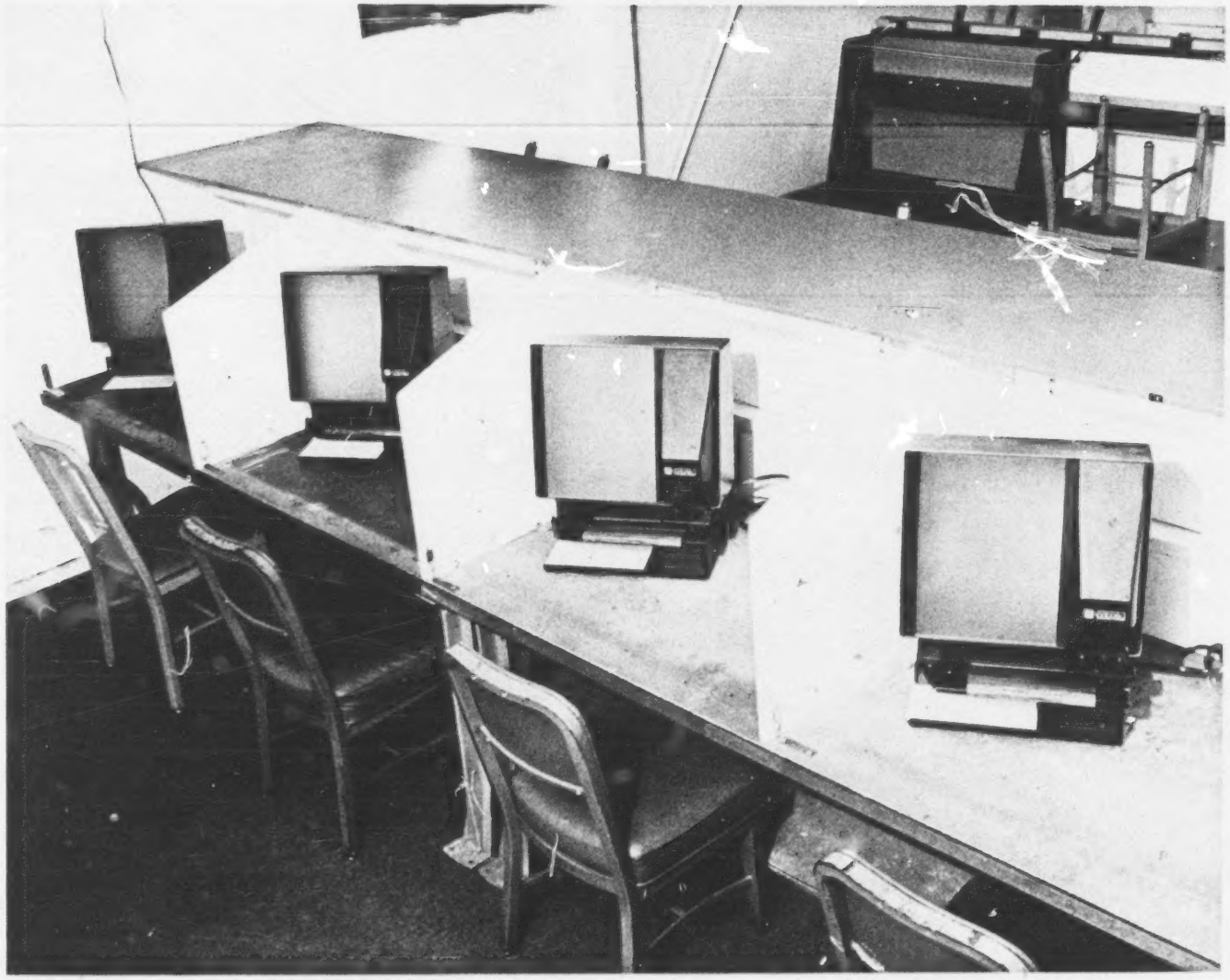

Figure 2. Learning Carrels

SECTION III

RESULTS AND DISCUSSION

The results of the demonstration are organized according to instructor and trainee responses to questionnaire items. Opinions from these two frames-of-reference are compared and contrasted to illustrate the feasibility of using sound/microfiche vice sound/slide presentations.

QUESTIONNAIRE RESPONSES

The questionnaire (appendix A) was designed to solicit responses regarding Operational Factors, Physical Comfort, Study Habits, Attitudes, and Recommendations. Response frequencies for instructors and trainees are presented by questionnaire item in table 1. Disagreements between instructors and trainees which are significantly different from chance are noted in the table. The chi-square test with Yate's correction (Siegel, 1956) is conservative; therefore, only large diffferences are noted as significantly different from chance.

On the majority of questionnaire items instructors and trainees responded similarly. In general, both groups expressed little difficulty in adapting to the microfiche medium.

Opinions of instructors and trainees differed significantly on 5 of the 18 questions. The trainees were less critical of the legibility of the text and the illustrations (questions 5 and 6). Several instructors responded that there were more distractions using the sound/microfiche than the sound/slides (question 9). The trainees had fewer preconceived attitudes toward using microfiche prior to reviewing the sound/microfiche programs (question 13). The majority of the trainees felt that use of sound/microfiche would improve BE&E training while the instructor opinions were fairly evenly divided (question 17).

Most of the questionnaire items addressed specific characteristics of the microfiche compared to slides. For these items, space was provided for the subject to elaborate on his response. The following discussion of questionnaire responses includes the write-in comments by questionnaire section.

OPERATIONAL FACTORS

The majority of subjects had no problems in synchronizing the audio and visual. A few instructors objected to the contrasting female voice for giving directions; however, none explained why this was objectionable. Some suggested using a simple tone or beep to signal a frame change.

TABLE 1. QUESTIONNAIRE RESPONSE FREQUENCIES

No.			I	T	x^2
	OPERATIONAL FACTORS				
1.	Did you have any problems in synchronizing the microfiche frames with the sound presentation?	Yes	5	1	
		No	15	19	
2.	Do you have any recommendations for improving the microfiche/sound synchronization?	Made Recommendations	8	4	
		Made No Recommendations	12	16	
3.	Did you have any problems in following the tracking path sequence of the microfiche frames?	Yes	5	3	
		No	15	17	
4.	Do you have any recommendations for improving the tracking path of the microfiche frames?	Made Recommendations	6	1	
		Made No Recommendations	14	19	
5.	Was the legibility of the microfiche text adequate?	Yes	11	18	
		No	9	2	**
6.	Was the legibility of the microfiche illustrations adequate?	Yes	8	15	
		No	12	5	*
	PHYSICAL COMFORT				
7.	How much eyestrain did you experience using microfiche compared to slides?	More	10	6	
		Less	2	6	
		Same	8	8	
8.	How much body fatigue did you experience using microfiche compared to slides?	More	2	2	
		Less	1	7	
		Same	17	11	
9.	Were there any more distractions using microfiche compared to slides?	Yes	8	1	
		No	12	19	*

* = $p < .05$
** = $p < .01$

TABLE 1. QUESTIONNAIRE RESPONSE FREQUENCIES (continued)

No.			I	T	x^2
	STUDY HABITS				
10.	Were you able to study just as long at one sitting using microfiche compared to slides?	Yes	18	18	
		No	2	2	
11.	Do you think that the audio/visual presentations would be used more if they were readily available in the learning centers?	Yes	15	16	
		No	1	2	
		No Difference	4	2	
	ATTITUDES				
10.	Have you used any kind of microfilm before?	Yes	20	20	
		No	0	0	
13.	What was your attitude toward using microfiche before you saw the colored microfiche?	Positive	12	3	
		Negative	1	3	*
		No Opinion	7	14	
14.	Did your attitude toward using microfiche change after you had seen the colored microfiche?	More Positive	7	14	
		More Negative	2	0	
		No Change	11	6	
15.	Would you prefer to use sound/microfiche or sound/slides in the BE&E curriculum?	Microfiche	9	15	
		Slides	6	2	
		No Preference	5	3	
	RECOMMENDATIONS				
16.	What recommendations would you make for improving the audio/visual presentation on microfiche?	Made Recommendations	17	11	
		Made No Recommendations	3	9	
17.	If the BE&E Modules and slide presentations are put on microfiche, the need for slide projectors and special learning carrels can be eliminated. How do you think this would affect BE&E training?	Improve Training	6	14	
		Detract From Training	8	1	*
		No Change	6	5	
18.	Use this space for any additional comments, criticism, or recommendations.	Made Comments	12	11	
		Made No Comments	8	9	

Several subjects reported some initial confusion with the frame sequencing path. Two major objections were noted: (1) the arrows on each frame pointed in the direction of the next frame in the sequence; however, the movement of the carrier/index pointer was opposite; (2) the tracking path sequence (i.e., "S" pattern) was in conflict with the other microfiche used in the BE&E School. The microfiche used for testing have a left-right, left-right tracking pattern. It was suggested that all microfiche used in the school be consistent in this regard.

Instructors and trainees differed significantly in their judgment of the text legibility. It appears that most negative responses were in regard to one microfiche frame (out of a total of 218) which was a poor quality photograph of a typewritten page. It was suggested that a bolder type be used.

The instructors were significantly more critical of the illustration legibility. Negative comments focused on two areas: (1) the VTVM (13/4) presentation had several photographs of meter dials which were illegible; and (2) some colors (e.g., brown/black, grey/silver) in the Resistor Color Code (3/3) presentation were difficult to differentiate.

PHYSICAL COMFORT

The majority of subjects reported that the microfiche produced the same amount or less eyestrain than viewing slides; however, a few comments recurred. Several subjects suggested using a shroud to shield the screen from ambient light to reduce glare. Several also suggested a variable brightness control to compensate for differences between frame contrast, personal preference, and ambient illumination.

Most subjects reported the same amount or less body fatigue from using microfiche versus slides. Several trainees felt that there was less body fatigue as a result of manually manipulating the microfiche carrier vice maintaining a more constant body position during the slide presentation.

Several instructors viewed attending to the reader to change frames as a distraction. The trainees differed significantly, expressing the notion that this activity heightened their attentiveness.

STUDY HABITS

Instructors as well as trainees felt that the A/Vs would be used more if they were readily available in the learning centers. Write-in comments addressed a reluctance to use the A/Vs under the present system due to the inconvenience of leaving the learning centers to sign out and review the programs.

ATTITUDES

The majority of the trainees reported a neutral attitude toward microfiche before reviewing the sound/microfiche programs. The instructors had positively polarized attitudes, probably due to their comparatively greater experience in using microfiche. The trainees experienced the greatest attitude change (in the positive direction) after the demonstration.

Most of the subjects stated a preference for using sound/microfiche vice sound/slides in the BE&E curriculum.

RECOMMENDATIONS (Responses to questionnaire section titled "Recommendations")

Many instructors and trainees were critical of the quality of the audio portions. Great care was taken to produce high quality audio tapes; however, the cassette players used in the school were inexpensive and of low quality which may account for inaccurate speeds and spurious background noise. In no instance was the audio portion unintelligible; however, subjects recommended upgrading the quality of the audio.

Most other recommendations were reiterations of earlier comments. Although noted by only one subject, two points were made which seem worthy of note. One individual suggested limiting the amount of information on a given frame, for clarity. Another suggested using an appropriate storage container for the microfiche as the image may be quickly degraded by handling and dust.

When presented a hypothetical situation where all instructional materials would be put on microfiche, available to all trainees in their learning centers, the majority of trainees felt that BE&E training would be enhanced. Most felt that this would result in greater use of the A/Vs due to easier accessibility. The opinions of the instructors differed significantly with the common logic that this would be too costly as each trainee would also require a microfiche reader in his barracks for optional night study.

OVERALL RESULTS

To compare the overall responses of instructors versus trainees, an analysis of variance was performed on the number of positive responses of the two groups on questions 1, 3, 5, 6, 7, 8, 9, 10, 11, 15, 17, and the net value of 13/14. For this analysis, a positive response was defined as one which indicated no problem with operational factors, physical factors, and study habits, as well as positive attitudinal

responses. The mean number of positive responses by category and group is presented in table 2.

TABLE 2. MEAN POSITIVE RESPONSES ON TWELVE QUESTIONNAIRE ITEMS

CATEGORY	GROUP			
	1	2	3	4
Instructors	5.8	5.6	7.2	6.2
Trainees	9.0	7.2	10.6	9.4

The effects of group and category membership on the number of positive responses were examined using a two-way analysis of variance. It was found that trainees elicited a significantly greater number of positive responses than instructors ($F_{1,32} = 19.28$, $p < .0002$). The main effect of groups was not significant at the .05 level).

Overall, the responses of the trainees were significantly more positive (in favor of microfiche) than the instructors. The results give the impression that the trainees responded from a generalized positive point of view vis-a-vis the microfiche medium. The instructors, on the other hand, seemed to focus more on the technical facets of using sound/microfiche. There are apparent shortcomings which make the validity of both approaches suspect.

It should have been apparent to an objective observer that two of the microfiche were marginally acceptable, at best, in terms of detail resolution and color discrimination. Yet, the trainees deemed these to be acceptable. They may have been biased by the novel nature of this medium and/or reluctant to be critical considering their adaptation to a highly structured military environment. In more positive terms, however, there seems to be a certain unbiased, youthful enthusiasm to try something new, as previously observed (Keeler and Rizzo, 1976).

The instructors, in some instances, seemed to be extremely critical of even the most minor shortcoming. Many were sufficiently distressed as indicated by references to a single, poorly resolved, typewritten page to rate the overall legibility of the text "inadequate."

While the effect of group membership was not significant at the .05 level, the trend of response is worthy of note. The groups (1 and 3) that reviewed the two microfiche (with audio) with the most frequently noted shortcomings, responded more positively. Groups 2 and 4 reviewed

these microfiche without audio, getting cues strictly from the visual presentation. It is possible that the audio presentation helped to clarify the lack of resolution and color distinction in the microfiche.

It is suggested that both groups of raters were biased; i.e., either too lenient or too critical. This bias may be due, in part, to the subjective nature of the questionnaires. It is common to find subjective ratings to be contaminated with halo error; i.e., a general, overall attitude or impression which permeates the ratings of subcomponents (Rizzo, 1975).

SECTION IV

COST ANALYSIS

To illustrate the comparative costs of implementing an A/V facility in an operational training environment, three hypothetical alternatives were compared. Comparisons are made based on the existing configuration of the BE&E School, Orlando.

Alternative A/V systems are described as follows:

Alternative A

A dedicated A/V area of approximately 128 ft.^{2} with the following equipment:

- 4 Howe Carrels, Model T/E-SS
- 4 Howe Rear Projection Modules, Model PM-10
- 6 Kodak Ektagraphic Slide Projectors, Model AF-1
- 6 Bell and Howell Cassette Players, Model 3025

Alternative B

A dedicated A/V area of approximately 128 ft.^{2} with the following equipment:

- 4 Howe Carrels, Model T/E-SS
- 6 Realist/Vantage I Microfiche Readers
- 6 Bell and Howell Cassette Players, Model 3025

Alternative C

No dedicated A/V area. This alternative assumes that the BE&E course materials have been published on microfiche and that each trainee has a microfiche reader as part of his individual learning carrel. The only additional hardware required are 12 Bell and Howell Cassette Players, Model 3025.

Under Alternatives A and B, the A/V programs are stored and issued from a centralized location, such as supply. The learning center supervisors store and issue A/V programs within their learning centers under Alternative C.

Numerous assumptions were made in order to compare these three alternatives. Where indefinite or highly variable factors are considered, conservative estimates were made. For example, the cost of floor space

may vary from zero, where existing facilities are readily and abundantly available, to some considerable amount where facilities are crowded and use of floor space may impact the average number of trainees onboard. The following is a list of the general assumptions for comparing the three alternatives:

1. The A/V capability will be initiated assuming none of the hardware/software resources are on hand.

2. The A/V facility will support the existing average on board (AOB) at the BE&E School, Orlando.

3. The planning period is 10 years.

4. A discount rate of 10 percent is applied. This is the interest rate used in calculating the present value of expected yearly costs and benefits. It represents the accepted price of money or the interest rate currently obtainable on loanable funds.

5. A 50 percent backup is required for projectors, microfiche readers, and cassette players.

6. There are no differential learning effects--microfiche vs. slides. Time to reach training objectives is equal for all alternatives.

7. Floor space rental is $\$5/ft.^2$

8. Hardware costs do not reflect quantity purchase discounts.

9. Maintenance costs across alternatives are equivalent.

10. Additional storage space required is equivalent and minimal.

11. Cost of audio production is constant across alternatives.

12. Original artwork is equivalent across alternatives.

13. Software production/reproduction costs are commercial rates (e.g., Eastman Kodak).

14. The rate of consumption of microfiche is estimated to be considerably greater than that of slides as the microfiche will be manually manipulated. The substitution ratio is not known; therefore, cost data on four numbers of copies are presented.

15. It is estimated that a minimum of three copies of the slide programs are required. Cost data are presented for six copies, as well.

16. The remaining value of software at the end of the planning period is assumed to be zero, anticipating significant updating and revision of curriculum content.

The relative costs of each alternative for the 10-year planning period may be compared using the "Total Present Cost of System" (tables 3, 4, and 5). The present cost is a calculation of each year's expected cost multiplied by its discount factor and then summed over all years of the planning period.

The cost analysis was deliberately limited to a small facility to maximize the validity of parameters which may vary considerably in another environment. However, the relative cost of microfiche vs. slides with associated hardware seems straightforward and objective. When extrapolated to encompass the spectrum of Navy training facilities which might employ microfiche based A/V programs, the dollar savings may be appreciable.

The generalizability of this cost data is limited to similar contexts. Cost of alternatives in environments where use of floor space is expensive, existing equipment is to be replaced, throughput or AOB is affected, etc., may vary dramatically. It is imperative that situation-specific cost analyses be performed prior to choosing an optimum instructional delivery system.

TABLE 3. COST ANALYSIS OF THE BE&E SOUND/SLIDE AUDIO/VISUAL FACILITY--ALTERNATIVE A

	Initial Cost	Useful Life	Years In Planning Period 1	2	3	4	5	6	7	8	9	10	Remaining Value	Present Cost
Equipment														
Carrels (4)	$ 350	25 yrs.											$ 510	$ 504
Projectors (6)	857	15											286	702
Magazines (78)	287	15											96	235
(140)	515	15											172	422
Cassette Players (6)	348	10											0	332
Facilities														
Floor Space (128 ft.^{2})	640		640	640	640	640	640	640	640	640	640	640		4,129
Medium														
Slide Production	5,046	5						3785					0	7,055
Original + 3 cys	8,831	5						7569					0	12,906
Original + 6 cys														

TOTAL PRESENT COST OF SYSTEM	
3 Copies of Slides	$13,057
6 Copies of Slides	19,095

TABLE 4. COST ANALYSIS OF THE BE&E SOUND/FICHE AUDIO/VISUAL FACILITY--ALTERNATIVE B

	Initial Cost	Useful Life	Years In Planning Period 1	2	3	4	5	6	7	8	9	10	Remaining Value	Present Cost
Equipment														
Carrels (4)	$562	25 yrs.											337	$400
Projectors (6)	1056	8									1056		792	1156
Magazines	0												0	0
Cassette Players(6)	348	10											0	332
Facilities														
Floor Space (128 ft.^{2})	640		640	640	640	640	640	640	640	640	640	640		4129
Medium														
Fiche Production														
Orig. + 25 cys.	2541	5						788					0	2891
Orig. + 50 cys.	3329	5						1575					0	4108
Orig. + 75 cys.	3722	5						1969					0	4716
Orig. + 100 cys.	4022	5						2268					0	5180

TOTAL PRESENT COST OF SYSTEM	
25 Copies of Fiche	$ 8,909
50 Copies of Fiche	10,125
75 Copies of Fiche	10,733
100 Copies of Fiche	11,197

TABLE 5. COST ANALYSIS OF THE BE&E SOUND/FICHE AUDIO/VISUAL FACILITY--ALTERNATIVE C

	Initial Cost	Useful Life	Years In Planning Period 1	2	3	4	5	6	7	8	9	10	Remaining Value	Present Cost
Equipment														
Carrels	0													
Projectors	0													
Magazines	0													
Cassette Players (12)	$ 695	10 yrs											0	$ 663
Facilities														
Floor Space	0													
Medium														
Fiche Production														
Orig. + 25 cys	2541	5					788						0	2891
Orig. + 50 cys	3329	5					1575						0	4108
Orig. + 75 cys	3722	5					1969						0	4716
Orig. + 100 cys	4022	5					2268						0	5180

TOTAL PRESENT COST OF SYSTEM	
25 Copies of Fiche	$3,554
50 Copies of Fiche	4,771
75 Copies of Fiche	5,379
100 Copies of Fiche	5,843

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are divided into three categories: (1) supported by the results of this study, (2) technical recommendations by Eastman Kodak for color microfiche production, and (3) opinion based on the author's experience and observations.

STUDY-BASED CONCLUSIONS AND RECOMMENDATIONS

1. Sound/microfiche appears to be a viable, cost-effective alternative to traditional sound/slide presentations. Cost savings may be quite significant in environments already employing the microfiche medium for other purposes. With the advent of the Personalized Portable Micromedia Display System (PPMDS) and the ever increasing trend toward micropublishing, the portability advantages of sound/ microfiche become apparent. It is recommended that primary consideration be given to this medium in initiating or renovating individualized A/V facilities.

2. The microfiche medium was positively received by both trainees and instructors. It has been noted, as well, in previous studies that trainees are particularly unbiased and receptive toward the use of microfiche. This demonstration reinforces other TAEG study results predicting no serious attitudinal problems from the trainee viewpoint in transitioning to microfiche from more traditional media. It is strongly suggested, however, that the key to success of a microfiche-based instructional delivery system lies in the quality of both hardware and software.

3. Wherever possible, individualized A/V capabilities should not be remotely located from the learning centers. The logistics of trainees moving about to acquire training materials and to access separate A/V carrels wastes training time and has a general disruptive effect on other trainees. It is expected that greater use would be made of optional A/V programs if they are readily available in the learning centers.

4. Color microfiche should be produced from original artwork, drawings, photographs, etc. Successive generations (i.e., rephotographing) of input materials may detract significantly from the original quality.

5. The frame sequencing scheme should not conflict with other microfiche used. The left-right, left-right sequence is the most common.

6. Arrows on frames indicating the direction of sequencing should be avoided unless the microfiche reader lacks an alphanumeric index.

7. It is assumed that microfiche readers will rarely be used in an environment of carefully controlled ambient lighting. To compensate for environmental variability, it is recommended that readers include a viewing screen shroud and a variable illumination control. These features are an integral part of, or an option on, many commercially available readers.

8. Simple instructions at the beginning of the audio presentation are useful to insure proper loading of microfiche, reader operation, and frame sequencing. This is particularly important where trainees use the medium only occasionally.

KODAK (1975) RECOMMENDATIONS

1. The amount and complexity of information presented per frame should be kept clear and simple.

2. Clear, bold graphics and large-type fonts are imperative. The use of 12-point type or larger, sans serif, is recommended.

3. Select background colors that will complement--not conflict with--main subject matter. Matte surface pastel colors are recommended. Plain white or glossy backgrounds can cause glare and contrast problems.

4. The 1/24X reduction ratio used in this demonstration is probably the greatest useful ratio for color applications. Smaller reduction ratios are advisable for including finer details. The reduction ratio selected should also be compatible with the microfiche readers to be used.

ADDITIONAL OBSERVATIONS AND RECOMMENDATIONS

1. Where color differentiation is critical, select shades which contrast as much as possible. For example, where black and brown must be distinguishable, select a lighter shade of brown.

2. A frame sequencing diagram in the A1 frame position is helpful. These may be included as original artwork or obtained commercially.

3. Readers to be used for color microfiche should have neutral density as opposed to tinted viewing screens, which tend to distort colors.

4. Quality audio production and reproduction is important. Care should be taken to insure the fidelity of tone, accuracy of speed, and accessibility of tape heads for periodic cleaning and demagnetizing.

5. Voice instructions or contrasting voice instructions are recommended over a simple tone for frame change cues.

6. Appropriate scratch resistant and dust free storage containers are advisable to increase the useful life of microfiche. A variety of commercial products is available for this purpose.

REFERENCES

Keeler, F. L. and Rizzo, W. A. An Evaluation of Microfiche Reader Types for Use with Programmed Instruction. TAEG Report No. 35. August 1976. Training Analysis and Evaluation Group, Orlando, Florida. AD A029714.

Kodak. Guidebook for Color Microfiche Input and Production. 1975. Rochester: Eastman Kodak Company.

Rizzo, W. A. Influence of Irrelevant Cues and Alternate Forms of the Graphic Rating Scale on the Halo Effect. Unpublished master's thesis. 1975. Florida Technological University. Orlando, Florida.

Siegel, S. Nonparametric Statistics. New York: McGraw Hill. 1956.

APPENDIX A

BE&E SOUND/MICROFICHE QUESTIONNAIRE

Name_____Title_____

Age_____Pay Grade_____

Do you wear glasses_____contacts_____bifocals_____for reading?

The purpose of this questionnaire is to solicit your opinions concerning the sound/microfiche demonstration. This information will remain strictly confidential and will not become part of your military records.

OPERATIONAL FACTORS

1. Did you have any problems in synchronizing the microfiche frames with the sound presentation? Yes _____ No _____ Explain _____

_____

_____

2. Do you have any recommendations for improving the microfiche/sound synchronization? Yes _____ No _____ Explain _____

_____

_____

3. Did you have any problems in following the tracking path sequence of the microfiche frames (i.e., left to right, then right to left)?

Yes _____ No _____ Explain _____

_____

_____

4. Do you have any recommendations for improving the tracking path of the microfiche frames? Yes _____ No _____ Explain _____

_____

_____

5. Was the legibility of the microfiche text adequate? Yes _____

No _____ Explain _____

_____

_____

6. Was the legibility of the microfiche illustrations adequate? Yes

_____ No _____ Explain _____

_____

PHYSICAL COMFORT

7. How much eyestrain did you experience using microfiche compared to slides? More_____ Less_____ Same_____ Explain_____

_____

_____

8. How much body fatigue did you experience using microfiche compared to slides? More_____ Less_____Same_____Explain_____

_____

_____

9. Were there any more distractions using microfiche compared to slides? Yes_____ No_____ Explain_____

_____

_____

STUDY HABITS

10. Were you able to study just as long at one sitting using microfiche compared to slides? Yes_____ No_____ Explain_____

_____

_____

11. Do you think that the audio/visual presentations would be used more if they were readily available in the learning centers? Yes_____ No____

No difference_____

ATTITUDES

12. Have you used any kind of microfilm before? Yes_____ No_____

Explain_____

_____

13. What was your attitude toward using microfiche before you saw the colored microfiche? Positive_____ Negative_____ No Opinion_____

14. Did your attitude toward using microfiche change after you had seen the colored microfiche: More Positive_____ More Negative _____ No Change_____

15. Would you prefer to use sound/microfiche or sound/slides in the BE&E curriculum? Microfiche_____ Slides_____ No Preference _____

RECOMMENDATIONS

16. What recommendations would you make for improving the audio/visual presentation on microfiche? _____

_____

_____

_____

17. If the BE&E modules and slide presentations are put on microfiche, the need for slide projectors and special learning carrels can be eliminated. How do you think this would affect BE&E training: Improve training_____ Detract from training_____ No change_____Explain_____

_____

_____

18. Use this space for any additional comments, criticism, or recommendations.

_____

_____

_____

_____

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